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Educational projects evaluation: willingness to pay *vs* social utility

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Abstract

In this paper the "willingness to pay" (wtp) approach and the utilitaristic one are compared in order to evaluate an educational project, such as an investment in human capital. In the first part, the differences between the two approaches are underlined. In the second part we show the important role that education can play on the probability of finding a job. In the third part a suitable model is introduced and the conditions under which the wtp approach systematically overestimates (or respectively underestimates) the social value of an educational program are shown. In all the considered cases, however, the wtp criterion seems not to be a suitable measure of educational social welfare.

Keywords: Education; human capital; willingness to pay (wtp); social utility; evaluation.

1. Introduction

In the education field, economic evaluations are often used as support in decision making. The role played by those instruments seems to be increased by two factors:

1. the amplified demand for education services (also and above all at university and post-university level);
2. the narrow possibilities of supply in a field characterized by limited (often insufficient) resources (both financial and non financial).

If it is necessary to choose among alternative solutions in conditions of limited economic funds, the evaluation should analyze:

1. the costs of the single education projects, including the so-called opportunity-costs, deriving from the giving up of possible alternatives;
2. the benefits of the single actions, that is, all the positive consequences arising from the possible realization of the considered alternative.

In such sense, economic evaluations do not have to be perceived only as instruments with the aim of limiting the costs of education; on the contrary, their role is to support the decision makers in choosing the most effective action, guaranteeing at the same time an optimal allocation of all the available resources (Ben-Yashar and Paroush 2003).

It is also necessary to underline that the choice among alternative actions usually takes place under uncertain

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conditions. The effects deriving from the realization of a specific action are linked to personal situations[2]. Therefore economic evaluations do not necessarily lead to choose the educational plan among those compared; they allow to point out only the project that, under such conditions, seems to be the most rational[3].

There are numerous evaluation models proposed in the literature: they constitute a set of rules (more or less shared) destined to guide public decision makers in the choice among compared alternative solutions; the aim is to determine the project or the projects that maximize the social welfare. The will to achieve such objective has stimulated the development of numerous economic theories and models. It is necessary to emphasize, in this sense, that universally accepted standards do not exist for such economic analyses: many of the proposed methodologies, in fact, are still debated or in phase of development. A thorough review of such methods falls beyond the scope of this paper; the attention will be here focused exclusively on two approaches, the utilitaristic and the so-called "willingness to pay" (wtp) approaches.

Since it was proposed by von Neumann and Morgenstern (1944), the theory of the expected utility played a dominant role in the solution of the decision problems exposed to risk and/or uncertainty. Among them it is possible to insert those problems linked to the possible realization of public educational projects[4]. They represent an opportunity for unemployed young people to invest in their human capital and, in so doing, increasing the chance of success in a their career (i.e., the chance – but not the certainty – of finding a well paid job), just investing on their human capital.

The problems in the application of the traditional economic instrument increase when we try to attribute a monetary value to assets that are not usually exchanged (bought or sold) on the market, or for which the observed market price is not a reliable measure of their social value. In particular, if the market always was characterized by perfect competition and if there always was an equilibrium between supply and demand, the price of produced goods (or services) would express the (maximum) wtp by the consumers (given their preferences), and the ability of the producers to realize the same goods at the lowest technically possible cost. In these cases, prices observed on the market would suitably reflect the value of the resources that a project consumes and of those it generates *ex novo* (Nuti 2001).

Alternatively, it would be necessary to determine the amount of money that the single agent or the community as a whole are willing to pay in order to benefit of a change of their well-being or in order to preserve the actual well-being[5]. The wtp, in such sense, represents the heart of the contingent valuations, which are usually based on direct survey and allow a company to determine the value that the community attributes to goods which are not traded in a market. The use of the contingent valuation in the elicitation of the wtp for a hypothetical change in the supply of public goods has found supporters[6] and critics[7].

After underlying the role that education plays on the probability to find a job (see par. 2), a rather general model is introduced with the aim of underlining possible distortions created by the wtp approach in the valuation of an educational project, as opposed to the value assessed by the utilitaristic approach (see par. 3). This topic has been little debated in literature (Armantier and Treich 2004). This paper represents an attempt to fill the gap in the matter of public choices concerning educational programs.

2. Investments in human capital, employability and earnings

In the economy of education some questions have been at the centre of attention for decades. For example, it is frequently asked why people spend an ever increasing amount of time on education, what are the costs and the gains of such an investment, and why do countries seem to assign greater amounts of resources to the education of their young people (Gradstein and Justman 2000; Salinas-Jiménezet et al. 2006).

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[2] The benefits that each student gets from a Master degree or a course of vocational formation are obviously linked to the abilities and the efforts made by the single student.

[3] The goodness of the choice, usually, cannot be demonstrated ex post (that is after the realization of the action), given the absence, in the same context, of an alternative.

[4] Consider, for instance, a Public Administration that has to decide whether to finance a vocational course or a Master Degree course.

[5] In the specific case, we can think to an educative project that, if realized, would increase for the students the chance of finding a job, by the use of collective resources to cover organizational costs (see. par. 3).

[6] See, inter alia, Mitchell and Carson (1989) and Carson et al. (1995).

[7] See, inter alia, Hausman (ed., 1993).

After the publication of Mincer's (1958, 1974) and Becker's (1964) papers, education has been considered as an investment in human capital, with its relative costs, gains and rates of return. Just the calculation of such rates is one of the main problems faced by economists; its solution could constitute the answer to some of the previous questions (and perhaps to many others).

For approximately five decades, literature has shown a positive incidence of the educational level on the income (Card 1999, for a review; Ishikawa and Ryan 2002). Moreover, the most educated individuals, *coeteris paribus*, seem to pass a greater amount of time at work rather than being unemployed; in particular, the unemployment rate decreases as the education level increases in almost all the Countries of the OECD[8]. Furthermore, workers with a higher level of formal education find a job faster than less educated individuals (Devine and Kiefer 1991, for a survey).

Usually, the literature that estimates the incidence on incomes differs from the literature that examines the relationship between education and (un)employment[9]: the former implicitly implies that higher levels of income are the only effect of education. The incidence on employability, instead, is often neglected or examined separately. Since earnings are a combination of salary and time dedicated to the job, both aspects need to be examined. In the literature there are not many contributions that have examined the incidence of employability on annual income (Ashenfelther and Ham 1979; Nickell 1979).

As previously said, a good level of education and a better qualification seem to represent one sure answer to the risk of unemployment. It is not by chance that in the last years many developed economies have increased the percentage of their budgets towards the field of education[10].

It is necessary to remember, in such a case, the importance of decisions about the investments in education – such as those related to the other supplies of the public sector – regarding the amount of collective resources to be reserved for such services and the question of which of these services are to be the main objectives[11].

The shortage of available public resources, in fact, prevents the satisfaction of all the increased needs of society (such vision had been synthesized already in 1962 by Galbraith with the memorable expression «*Public squalor, private splendor*»). Anyway, many countries also perceive the necessity of reducing public expenditure. A question unavoidably arises from such discrepancies about the most opportune economic evaluation methods of public services, with the aim of guaranteeing a supply that, as much as possible, is at the same time efficient and effective.

3. A simple model

There are n agents in the economy. Each of them lives two periods: in the first period he looks for a job; in the second period he can either find a job or remain unemployed. At the beginning of the first period the agent $i = 1,...,n$ will have a wealth w_i [12] and a probability p_i of becoming employed. This last status would guarantee him an income $y_i > 0$ in the second period. The probability of remaining unemployed is instead equal to $(1 - p_i)$. In the same time interval, therefore, his expected utility will be $p_i u(w_i + y_i) + (1 - p_i) u(w_i)$, with $u(.)$ that represents the utility function of the money. Assume, in such sense, that all the agents have the same utility function $u(.)$[13] and this is increasing, twice differentiable and concave.

The decision maker can choose if a course has to be organized or not in the first period; if attended, it would increase of $\varepsilon_i > 0$ the probability of the agent i finding a job in the following period. Therefore, his probability of becoming employed would increase to $(p_i + \varepsilon_i)$, while the probability of remaining unemployed would be reduced to $(1 - p_i - \varepsilon_i)$. In case the course had to be activated, the per capita cost would be c, independently from the number of individuals who will actually attend the course[14].

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[8] For a thorough analysis, see inter alia OECD (2009).

[9] For a thorough analysis, see Mincer (1991a, 1991b), Nickell and Bell (1995), McKenna (1996) and Kettunen (1997), Castelló and Doménech (2002).

[10] For a thorough analysis, see OECD (2009) and Eurydice (2002) among the others.

[11] The need of taking into care economic evaluations about services distributed by public agencies arises, first of all, from the necessity to justify the relative expense to face the possible supply of alternative services.

[12] w_i can be thought as an inheritance or as an endowment that the individual receives from his parents when he becomes economically independent from them.

[13] This is a restrictive hypothesis that permits interpersonal comparisons of utility levels among individuals.

[14] It could be, as an example, a general fiscal imposition necessary to cover the cost of the project if this was approved.

According to the first method, the course would have to be instituted if and only if

$$\Delta U = \sum_{i=1}^{n} \{[(p_i + \varepsilon_i)u(w_i + y_i - c) + (1 - p_i - \varepsilon_i)u(w_i - c)] - [p_i u(w_i + y_i) + (1 - p_i)u(w_i)]\} > 0 \,. \tag{1}$$

In other words one expects that, as a result of the educative project, the social utility increases (takes on a positive variation). Using a first-order Taylor development around $(w_i + y_i)$, we get that:

$$u(w_i + y_i - c) \cong u(w_i + y_i) + u'(w_i + y_i)(-c) \;; \tag{2}$$

analogously, around w_i, we get that:

$$u(w_i - c) \cong u(w_i) + u'(w_i)(-c) \,. \tag{3}$$

Inserting eqs. (2) and (3) into condition (1), the latter is almost equivalent to:

$$\Delta U \cong \sum_{i=1}^{n} \{(p_i + \varepsilon_i)[u(w_i + y_i) - cu'(w_i + y_i)] + (1 - p_i - \varepsilon_i)[u(w_i) - cu'(w_i)] + \\ - [p_i u(w_i + y_i) + (1 - p_i)u(w_i)]\} > 0 \,. \tag{4}$$

Note that condition (4) holds if:

$$B = \frac{\sum_{i=1}^{n} \varepsilon_i [u(w_i + y_i) - u(w_i)]}{\sum_{i=1}^{n} [(p_i + \varepsilon_i)u'(w_i + y_i) + (1 - p_i - \varepsilon_i)u'(w_i)]} > c \,. \tag{5}$$

The attention will be now focused on the wtp approach. The wtp z_i of agent *i*, with reference to the educational plan at hand, is defined by:

$$p_i u(w_i + y_i) + (1 - p_i)u(w_i) = (p_i + \varepsilon_i)u(w_i + y_i - c - z_i) + (1 - p_i - \varepsilon_i)u(w_i - c - z_i) \,. \tag{6}$$

Using, also in this case, a first-order Taylor development around $(w_i + y_i)$, we get that:

$$u(w_i + y_i - c - z_i) \cong u(w_i + y_i) + u'(w_i + y_i)(-c - z_i) \,. \tag{7}$$

Analogously, around w_i, we get that:

$$u(w_i - c - z_i) \cong u(w_i + y_i) + u'(w_i)(-c - z_i) \,. \tag{8}$$

Inserting eqs. (7) and (8) into condition (6), the latter is almost equivalent to:

$$p_i u(w_i + y_i) + (1 - p_i)u(w_i) \cong (p_i + \varepsilon_i)[u(w_i + y_i) - (c + z_i)u'(w_i + y_i)] + \\ + (1 - p_i - \varepsilon_i)[u(w_i) - (c - z_i)u'(w_i)] \,. \tag{9}$$

Through some algebra, we get that:

$$z_i \cong \frac{\varepsilon_i\left[u(w_i + y_i) - u(w_i)\right]}{(p_i + \varepsilon_i)u'(w_i + y_i) + (1 - p_i - \varepsilon_i)u'(w_i)} - c \ . \tag{10}$$

Passing from an individual level to an aggregated level, the average net wtp $\overline{Z}$ will be almost equal to:

$$\overline{Z} \cong \frac{1}{n}\sum_{i=1}^{n}\left\{\frac{\varepsilon_i\left[u(w_i + y_i) - u(w_i)\right]}{(p_i + \varepsilon_i)u'(w_i + y_i) + (1 - p_i - \varepsilon_i)u'(w_i)} - c\right\}. \tag{11}$$

Therefore, the wtp criteria reduces to verify if:

$$Z \cong \frac{1}{n}\sum_{i=1}^{n}\frac{\varepsilon_i\left[u(w_i + y_i) - u(w_i)\right]}{\left[(p_i + \varepsilon_i)u'(w_i + y_i) + (1 - p_i - \varepsilon_i)u'(w_i)\right]} > c \ . \tag{12}$$

It is necessary to specify that the criteria expressed by condition (12) is generally not equivalent to the social utility expressed by condition (5). Moreover there is the possibility that the two approaches lead to different decisions in relation to the same project. It is easy to demonstrate it through a simple example.

Example 1: Let us suppose, firstly, that the population is constituted by agents 1 and 2. The probabilities of finding employment in the second period are equal to $(p_1, p_2) = (0.75, 0.75)$; such probabilities will increase by $(\varepsilon_1, \varepsilon_2) = (0.05, 0.05)$ if a course was attended (with a per capita cost $c = 80$). Moreover, the two agents initially have a wealth $(w_1, w_2) = (100, 1000)$ and a job would guarantee them an income $(y_1, y_2) = (2000, 2000)$. The utility function that characterizes them is $u(x) = \log(x)$. Applying condition (5), we get $B \cong 72.75 < c = 80$, while using condition (12) we find $Z \cong 90.82 > c = 80$. In this specific case, the criteria based on the wtp tends to overestimate the value attributed to the project through the method of the social utility; moreover, the two approaches supply the decision maker with two contrasting results regarding the same course: in particular, by using the wtp approach, the project examined should have been approved; by using the social utility approach, on the contrary, the new educational course should not have been activated. Modifying the original wealth of the two agents to $(w_1, w_2) = (10000, 1000)$ and the per capita cost of the course to $c = 113$, other things being equal, applying condition (5), we get $B \cong 115.75 > c = 113$, while using condition (12) we find $Z \cong 111.45 < c = 113$. In this case the wtp method leads to underestimating the value attributed to the project through the social utility approach; moreover, the two criteria would supply the decision maker two different results regarding the opportunity of realizing the course, although contrasting with the results of the previous case. Indeed, based on the wtp approach, the project would have been rejected; whereas, according to the social utility criteria the new course should have been realized.

The question is under which conditions does the wtp approach lead systematically to overestimating or underestimating the value of the course obtained with the social utility approach?

From a mathematical point of view, the first criteria overestimates the values supplied by the second one if[15]

$$\frac{1}{n}\sum_{1=1}^{n}\frac{\varepsilon_i\left[u(w_i + y_i) - u(w_i)\right]}{(p_i + \varepsilon_i)u'(w_i + y_i) + (1 - p_i - \varepsilon_i)u'(w_i)} - \frac{\frac{1}{n}\sum_{i=1}^{n}\varepsilon_i\left[u(w_i + y_i) - u(w_i)\right]}{\frac{1}{n}\sum_{i=1}^{n}\left[(p_i + \varepsilon_i)u'(w_i + y_i) + (1 - p_i - \varepsilon_i)u'(w_i)\right]} =$$

$$= Z - B \geq 0 \ . \tag{13}$$

In order to answer this question it is useful to introduce the following Lemma.

[15] The introduction of the ratio *1/n* to the numerator and the denominator of B with respect to the formula (5) does not modify the latter, but it allows to simplify some demonstrations that follow.

Lemma 1: Take a positive increasing (decreasing) function $g(x): \Re \longrightarrow \Re$. The condition

$$\frac{1}{n}\sum_{i=1}^{n}\frac{f(x_i)}{g(x_i)} - \frac{\frac{1}{n}\sum_{i=1}^{n} f(x_i)}{\frac{1}{n}\sum_{i=1}^{n} g(x_i)} \geq 0 .$$

The proof is straightforward throughout the application of the Covariance rule.

The effects of the four various sources of heterogeneity will be now examined singularly.

Let us initially suppose that the heterogeneity regards exclusively the individual probabilities p_i of findir Imposing, therefore, $\varepsilon_i = \varepsilon \ \forall i$, $w_i = w \ \forall i$ and $y_i = y \ \forall i$, the inequality (13) reduces to:

$$\frac{1}{n}\sum_{1=1}^{n}\frac{\varepsilon[u(w+y)-u(w)]}{(p_i+\varepsilon)u'(w+y)+(1-p_i-\varepsilon)u'(w)} - \frac{\frac{1}{n}\sum_{i=1}^{n}\varepsilon[u(w+y)-u(w)]}{\frac{1}{n}\sum_{i=1}^{n}[(p_i+\varepsilon)u'(w+y)+(1-p_i-\varepsilon)u'(w)]} \geq 0 .$$

Through some algebra, the condition (15) reduces to:

$$\frac{1}{n}\sum_{1=1}^{n}\frac{1}{(p_i+\varepsilon)u'(w+y)+(1-p_i-\varepsilon)u'(w)} - \frac{1}{\frac{1}{n}\sum_{i=1}^{n}[(p_i+\varepsilon)u'(w+y)+(1-p_i-\varepsilon)u'(w)]} \geq 0$$

which always hold under Jensen's inequality.

So, in this case, the wtp criterion tends to systematically overestimating the value of the project define social utility method. It is easy to show it through another simple example.

Example 2: Let us suppose that the population is constituted by agents 1 and 2. The probabilities of employment in the second period are equal to $(p_1, p_2) = (0.90, 0.75)$; such probabilities will incr $(\varepsilon_1, \varepsilon_2) = (0.05, 0.05)$ if a course was attended. Moreover, the two agents initially have a $(w_1, w_2) = (1000, 1000)$ and a job would guarantee them an income $(y_1, y_2) = (2000, 2000)$. The utility funct characterizes them is $u(x) = \log(x)$. Applying condition (5), we get $B \cong 131.83$, while using condition find $Z \cong 133.76$.

Let now consider the source of heterogeneity regarding the change in probability ε_i that everyone atten course should have in finding a job in the second period. Then, imposing $p_i = p \ \forall i$, $w_i = w \ \forall i$ and y_i inequality (13) reduces to:

$$\frac{1}{n}\sum_{1=1}^{n}\frac{\varepsilon_i[u(w+y)-u(w)]}{(p+\varepsilon_i)u'(w+y)+(1-p-\varepsilon_i)u'(w)} - \frac{\frac{1}{n}\sum_{i=1}^{n}\varepsilon_i[u(w+y)-u(w)]}{\frac{1}{n}\sum_{i=1}^{n}[(p+\varepsilon_i)u'(w+y)+(1-p-\varepsilon_i)u'(w)]} \geq 0 .$$

Trough some algebra, the condition (17) further reduces to:

$$\frac{1}{n}\sum_{1=1}^{n}\frac{\varepsilon_i}{(p+\varepsilon_i)u'(w+y)+(1-p-\varepsilon_i)u'(w)}-\frac{\frac{1}{n}\sum_{i=1}^{n}\varepsilon_i}{\frac{1}{n}\sum_{i=1}^{n}\left[(p+\varepsilon_i)u'(w+y)+(1-p-\varepsilon_i)u'(w)\right]}\geq 0\,. \tag{18}$$

Applying Lemma 1 with $\varepsilon_i = x$, $g(x)=(p+x)u'(w+y)+(1-p-x)u'(w)$ and $f(x)=x$ yields that the sign on the left-hand side of condition (18) is always positive, since the function $g(x)$ is decreasing in x and the function $f(x)/g(x)$ is increasing in x.

Also, in this case, the wtp criterion tends to systematically overestimating the value of the project defined by the social utility method. It is easy to show it through another simple example.

Example 3: Let us suppose that the population is constituted by agents 1 and 2. The probabilities of finding employment in the second period are equal to $(p_1, p_2)=(0.75, 0.75)$; such probabilities will increase by $(\varepsilon_1, \varepsilon_2)=(0.10, 0.05)$ if a course was attended. Moreover, the two agents initially have a wealth $(w_1, w_2)=(1000, 1000)$ and a job would guarantee them an income $(y_1, y_2)=(2000, 2000)$. The utility function that characterizes them is $u(x)=\log(x)$. Applying condition (5), we get $B \cong 183.10$, while using condition (12) we find $Z \cong 185.62$.

Assuming that the heterogeneity of the population regards the income that every agent would earn in the second period in case of employment (independently from the attendance of the course in the previous period[16]). Therefore, imposing $p_i = p\ \forall i$, $\varepsilon_i = \varepsilon\ \forall i$ and $w_i = w\ \forall i$, inequality (13) reduces to:

$$\frac{1}{n}\sum_{1=1}^{n}\frac{\varepsilon\left[u(w+y_i)-u(w)\right]}{(p+\varepsilon)u'(w+y_i)+(1-p-\varepsilon)u'(w)}-\frac{\frac{1}{n}\sum_{i=1}^{n}\varepsilon\left[u(w+y_i)-u(w)\right]}{\frac{1}{n}\sum_{i=1}^{n}\left[(p+\varepsilon)u'(w+y_i)+(1-p-\varepsilon)u'(w)\right]}\geq 0\,. \tag{19}$$

Applying Lemma 1 with $y_i = x$, $g(x)=(p+\varepsilon)u'(w+x)+(1-p-\varepsilon)u'(w)$ and $f(x)=u(w+x)-u(w)$ yields that the sign of the left-hand side of condition (19) is always positive, since the function $g(x)$ is decreasing in x and the function $f(x)/g(x)$ is increasing in x.

Also, in this case, the wtp criterion tends to systematically overestimating the value of the project defined by the social utility method. It is easy to show it through another simple example.

Example 4: Let us suppose that the population is constituted by agents 1 and 2. The probabilities of finding employment in the second period are equal to $(p_1, p_2)=(0.75, 0.75)$; such probabilities will increase by $(\varepsilon_1, \varepsilon_2)=(0.05, 0.05)$ if a course was attended. Moreover, the two agents initially have a wealth $(w_1, w_2)=(1000, 1000)$ and a job would guarantee them an income $(y_1, y_2)=(3000, 2000)$. The utility function that characterizes them is $u(x)=\log(x)$. Applying condition (5), we get $B \cong 143.36$, while using condition (12) we find $Z \cong 145.50$.

If we finally consider that the source of heterogeneity is the initial wealth of the agents, imposing $p_i = p\ \forall i$, $\varepsilon_i = \varepsilon\ \forall i$ and $y_i = y\ \forall i$, inequality (13) reduces to:

$$\frac{1}{n}\sum_{1=1}^{n}\frac{\varepsilon\left[u(w_i+y)-u(w_i)\right]}{(p+\varepsilon)u'(w_i+y)+(1-p-\varepsilon)u'(w_i)}-\frac{\frac{1}{n}\sum_{i=1}^{n}\varepsilon\left[u(w_i+y)-u(w_i)\right]}{\frac{1}{n}\sum_{i=1}^{n}\left[(p+\varepsilon)u'(w_i+y)+(1-p-\varepsilon)u'(w_i)\right]}>0\,. \tag{20}$$

[16] It has been assumed, in fact, that the eventual attendance of the course affects positively the probability to become employed, not the flow of incomes.

In this case, imposing $w_i = x$, $g(x) = (p+\varepsilon)u'(x+y) + (1-p-\varepsilon)u'(x)$ and $f(x) = u(x+y) - u(x)$, by applying Lemma 1 again, it is not possible to identify the sign on the left-hand side of condition (20). In particular, the function $g(x)$ is decreasing in x. The function $f(x)/g(x)$ is represented by:

$$\frac{f(x)}{g(x)} = \frac{u(w_i + y) - u(w_i)}{(p+\varepsilon)u'(w_i + y) + (1-p-\varepsilon)u'(w_i)} \tag{21}$$

and it may be both increasing and decreasing in *x*. So, in this case, the wtp method could lead to either overestimating or underestimating the value of the project defined by the social utility criterion; this situation is already depicted with the Example 1.

All the previous Examples are summarized in Tab. 1.

Table 1 – Examples of contrasting results provided by wtp and social utility approaches for the same educational project

	Homogeneity		**Heterogeneity in p_i**		**Heterogeneity in ε_i**		**Heterogeneity in y_i**		**Heterogeneity in w_i**			
									case a		case b	
Agent	1	2	1	2	1	2	1	2	1	2	1	2
u(.)	log(.)	log(.)	log(.)	log(.)	log(.)	log(.)	log(.)	log(.)	log(.)	log(.)	log(.)	log(.)
p_i	0.75	0.75	**0.90**	**0.75**	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
ε_i	0.05	0.05	0.05	0.05	**0.10**	**0.05**	0.05	0.05	0.05	0.05	0.05	0.05
y_i	2000	2000	2000	2000	2000	2000	**3000**	**2000**	2000	2000	2000	2000
w_i	1000	1000	1000	1000	1000	1000	1000	1000	**100**	**1000**	**10000**	**1000**
Social utility approach (B in eq. 5)	117.71		131.83		183.10		143.36		72.75		115.75	
wtp approach (Z in eq. 12)	117.71		133.76		185.62		145.50		90.82		111.45	
	B = Z				B < Z				B < Z or B > Z			

Legend
u(.): agent's utility function of the money
p_i: agent's initial probability of becoming employed
ε_i: change in probability that every agent attending the course should have in finding a job
y_i: income that every agent would earn if employed
w_i: agent's original wealth

More in general, it was demonstrated that:

I if the heterogeneity regards only the original probability of finding a job, the wtp criterion tends to systematically overestimating the value of the project defined by the social utility method;

II if the heterogeneity regards only the change in probability that every agent attending the possible educational course would have in finding a job, the wtp criterion tends to systematically overestimating the value of the project defined by the social utility method;

III if the heterogeneity regards only the income that every agent would earn in the second period in case of employment, the wtp criterion tends to systematically overestimating the value of the project defined by the social utility method;

IV if the heterogeneity regards only the initial wealth of the agents in the population, the wtp approach could lead to either overestimating or underestimating the value of the project defined by the social utility criterion.

To understand I, consider a symmetric situation in which two identical individuals are willing to pay 100 for an increase of 1 in 100 of finding a job. Since there is no heterogeneity, aggregate wtp coincides with social utility. Thus the project has a value of 200. Now, suppose that the project has an effect only on a single individual, so that it increases his job opportunity by 2 in 100. It easy to demonstrate that the project has the same social value in both cases. However, the wtp in equation (10) is convex in p_i. Therefore, the aggregate wtp is now larger than in the symmetric situation. In other words, the wtp criterion overestimates the social value of a project because individuals' wtp increase non-linearly with a change in initial probability of finding a job.

To understand II, consider a symmetric situation in which two identical individuals face the same probability of finding a job. In this homogeneous society, the aggregate wtp for a probability increase program is equal to the

social value of the project. Now, suppose that the two agents face different baseline probabilities of the form $p_1 = p - \delta$ and $p_2 = p + \delta$. Note that the wtp z_i in equation (10) is convex in ε_i. Therefore, the aggregate wtp is now larger than the wtp in the symmetric situation, while the social benefit of the project is the same. In other words, the wtp criterion leads to overestimating the social value of the project.

The effect of income heterogeneity (statement III) may be intuitively understood considering the extreme case in which the distribution of income is assumed to be unbounded. In this situation, it is always possible to find a small number of individuals willing to pay for the entire project. In other words, there is no way to guarantee in this context that the wtp criterion will reject any socially inefficient project.

4. Concluding remarks

This paper is a theoretical attempt to investigate the relationship between wtp and social value of educative projects. At first it focuses on how economic evaluations can influence the decisional activities linked to educational projects, as possible investments in human capital (see par. 1). In particular, attention is focused on two alternative approaches, one based on the wtp and the other based on social utility. The aim is to determine under which conditions the first one lead to systematically overestimate (or underestimate) the social value of a educational project deriving from the application of the second one. Therefore, after underlying the role that education plays on the probability to find a job (see par. 2), a rather general model is introduced. This is characterized by four individual variables: initial wealth, occupational income, the chances of becoming employed and the change in the same probability deriving from the attendance of an educational program (see par. 3).

From a formal point of view it has been possible to demonstrate that if agents only differ on the initial probability of becoming employed, or on the change in same probability deriving from the attendance of the educational course, or on the future occupational income, then the wtp approach leads to systematically overestimate the value of the educational program given by the social utility method. No univocal conclusion, finally, is guaranteed when agents differ from each other only for their initial wealth. In all the considered cases, however, the wtp criterion seems not to be a suitable measure of educational social welfare.

Anyway, further research is necessary in order to estimate the magnitude of the distortion provided by the wtp approach, particularly in the presence of simultaneous sources of heterogeneity and agents' different utility functions of the money.

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Appendix

Proof of Lemma 1

According to covariance rule, let $g(.)$ a weakly increasing function, then $Cov[g(x),h(x)] \le 0$ for all x if and only if $h(.)$ is weakly decreasing. It implies that

$$\frac{1}{n}\sum_{i=1}^{n} g(x_i)h(x_i) - \frac{1}{n}\sum_{i=1}^{n} g(x_i)\frac{1}{n}\sum_{i=1}^{n} h(x_i) \le 0 . \tag{22}$$

Imposing $h(x_i) = f(x_i)/g(x_i)$, if $g(.)$ is positive, inequality (22) becomes

$$\frac{1}{n}\sum_{i=1}^{n} f(x_i) - \frac{1}{n}\sum_{i=1}^{n} g(x_i)\frac{1}{n}\sum_{i=1}^{n}\frac{f(x_i)}{g(x_i)} \le 0 \Rightarrow \frac{1}{n}\sum_{i=1}^{n}\frac{f(x_i)}{g(x_i)} - \frac{\frac{1}{n}\sum_{i=1}^{n} f(x_i)}{\frac{1}{n}\sum_{i=1}^{n} g(x_i)} \ge 0 . \tag{23}$$